(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 372 037 B1**

EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **11.08.93**

(51) Int. Cl.5: **G01F 1/30**, G01F 1/76, G01G 11/04

(21) Application number: **89905405.0**

(22) Date of filing: **03.05.89**

(86) International application number:
PCT/EP89/00490

(87) International publication number:
WO 89/11082 (16.11.89 89/27)

(54) METHOD OF AND APPARATUS FOR WEIGHING A CONTINUOUS STREAM OF FLUENT MATERIAL.

(30) Priority: **03.05.88 ZA 883122**

(43) Date of publication of application:
13.06.90 Bulletin 90/24

(45) Publication of the grant of the patent:
11.08.93 Bulletin 93/32

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(56) References cited:
DE-A- 1 802 213
DE-A- 2 950 925
US-A- 1 883 017
US-A- 4 238 956

(73) Proprietor: **Neumüller, Josef**
3 Highgate Lane
Bryanston Johannesburg(ZA)

(72) Inventor: **Neumüller, Josef**
3 Highgate Lane
Bryanston Johannesburg(ZA)

(74) Representative: **Lehn, Werner, Dipl.-Ing. et al**
Hoffmann, Eitle & Partner, Patentanwälte,
Postfach 81 04 20
W-8000 München 81 (DE)

EP 0 372 037 B1

Description

This invention relates to the weighing of material. More particularly, the invention relates to a method of, and apparatus for, weighing a continuous stream of fluent material.

DE-OS-2 950 925 describes a method and apparatus for measuring the throughput of granular materials. A vertically mounted feeding chute allows the granular material to fall directly into a sloping weighing chute. The horizontal component of the force exerted on the weighing chute is considered to represent the rate of flow of the material. In order to compensate for frictional effects, the speed of flow is measured by a device located at the end of the weigh chute. Based on the assumption that frictional forces are directly proportional to the speed of flow, a correction factor is calculated.

US-A-1 883 017 describes a device in which a feed chute is angled to be substantially co-aligned with a weigh chute. The measuring device used measures a value which is dependent upon frictional forces between the material and the weigh chute.

DE-A-1 802 213 describes a device with which the flowing material is forced to follow a curved profile formed by a feed surface and a weigh surface. The measuring device is influenced by the frictional forces between material and the weigh chute.

EP-A-0 152 388 describes a device in which the granular material falls vertically onto a plate. The inertial force exerted by the material is measured by sensing the deflection of the plate.

The object of the present invention is to provide a method and an apparatus for carrying out the method by which the weight of material flowing per unit time is measured more accurately than in the prior art methods.

The objects of the invention are solved by a method of weighing a continuous stream of fluent material comprising the steps: directing the material onto a feed means which, in the direction of flow of the material is arranged in a plane at an acute angle relative to a vertical plane at least at the outlet thereof; feeding the material into a weigh chute which is completely arranged in a plane at an acute angle relative to a vertical plane, at least the outlet of the feed means being arranged at substantially the same angle as the weigh chute and being co-axially aligned with the weigh chute; measuring the component of the load applied by the material to the weigh chute substantially perpendicular to the plane of the surface of the weigh chute thereby to neutralise the effect of any frictional forces generated between the material and the weigh chute and generating a first signal representative of mass of the material; measuring the speed of flow of the material and generating a second signal representative of the speed of flow of the material; and processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material.

Those skilled in the art will appreciate that, by arranging the said portion of the feed means at the same angle as the weigh chute, the material arriving in the feed means is stabilised in the feed means and then traverses the weigh chute at a substantially constant speed.

Further, those skilled in the art will appreciate that, by measuring the load applied by the material to the weigh chute in a plane substantially perpendicular to the plane in which the weigh chute is arranged, the effect of any frictional forces generated between the material and the weighing means is neutralised and it is not necessary to compensate for such frictional forces.

The object of the invention is also solved by an apparatus for weighing a continuous stream of fluent material comprising, a feed means, a weigh chute through which the material can pass which is completely arranged in a plane at an acute angle relative to a vertical plane; a load measuring means for measuring a component of the load imparted by the material to the weigh chute, said load measuring means being operable to generate a first signal representative of mass of the material; a speed measuring means for measuring the speed of flow of the material and for generating a second signal which is representative of the speed of flow of the material, and a processing means for processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material, characterized in that said feed means is arranged in use, in the direction of flow of the material, in a plane which is at an acute angle relative to a vertical plane at least at the outlet thereof; at least the outlet of the feed means is arranged at substantially the same angle as the weigh chute and being co-axially aligned with the weigh chute; and the load measuring means is arranged to measure the component of the load applied by the material to the weigh chute substantially perpendicular to the plane of the surface of the weigh chute, thereby to neutralise the effect of any frictional forces generated between the material and the weigh chute.

The feed means may comprise a feed chute. The said portion of the feed means and the weigh chute may be similarly dimensioned and shaped. Further, the feed means and the weigh chute may be of a material have a low co-efficient of friction. Thus, conveniently, the feed means and the weigh chute may be of polished stainless steel.

The load measuring means may comprise a load transducer which supports the weigh chute.

The speed measuring means may comprise a speed measuring wheel having a ribbed surface on which the material impinges to rotate the wheel, the wheel being arranged at an outlet end of the weigh chute and the speed measuring means may further include a monitoring means for monitoring the speed of rotation of the wheel, the monitoring means generating the said second signal.

The invention is now described by way of example with reference to the accompanying diagrammatic drawing which shows a schematic sectional side view of apparatus, in accordance with the invention, for weighing a continuous stream of fluent material.

Referring to the drawing, apparatus, in accordance with the invention, for weighing a continuous stream of fluent material, is illustrated and is designated generally by the reference numeral 10.

The apparatus 10 comprises a weighing means in the form of a weigh chute 12 which is arranged in a plane which is at an acute angle relative to a vertical plane. A load measuring means in the form of a load transducer 14 supports the weigh chute 12. The transducer 14 is arranged at substantially the same angle as the weigh chute 12 thereby to neutralise the effect of frictional forces generated between the material 16 flowing through the weigh chute 12 and teh weigh chute 12 itself.

A speed-measuring means 18 is arranged at an outlet end 12.1 of the weigh chute 12. The speed-measuring means comprises a speed measuring wheel 20 having a ribbed surface 22 on which the material 16 can impinge to cause the wheel 20 to rotate.

The wheel 20 is constructed of a relatively light-weight material to ensure low inertia and the wheel 20 is mounted on low-friction bearings to ensure that the running speed of the wheel 20 is proportional to the speed of the stream of material 16 leaving the weigh chute 12. A monitoring means in the form of a slotted disk 24 is fixed to a shaft on which the speed-measuring wheel 20 is mounted and the disk 24 rotates together with the wheel 20. The slotted disk 24 is operable to activate a proximity switch 26 which generates a signal comprising a pulse train representative of the speed of the stream of the material 16.

The apparatus 10 further inclused a feed means 28 for feeding the material 16 into an inlet end 12.2 of the weigh chute 12. The feed means 28 comprises a feed chute 30 having a curved portion 32 leading into a substantially rectilinear portion 34. The rectilinear portion 34 is arranged at substantially the same angle as the weigh chute 12 and the load transducer 14. The shape of the feed chute 30 ensures that the material 16 arriving in the feed chute 30 via an inlet opening 36 of the feed chute 30 stabilises in the feed chute 30 and slides into the weigh chute 12 at a constant speed. The feed chute 30 and the weigh chute 12 are made of polished stainless steel to reduce frictional forces generated between the portion 34 of the feed chute 30 and the weigh chute 12 and the material 16 sliding through the chutes 12 and 30.

In use, the material 16 to be weighed is fed into the feed chute 30 through the inlet opening 36 thereof and due to the shape of the feed chute 30 the speed of the material is stabilised such that when the material 16 flows into the weigh chute 12 the material is travelling at a substantially constant speed.

The load imparted by the material 16 to the weigh chute 12 is measured by the load transducer 14 and a first signal representative of mass of the material 16 is generated by the load transducer and is fed to a processing means 38. The material 16 exiting the weigh chute 12 impinges on the ribbed surface of the speed measuring wheel 20 causing it to rotate. The rotation of the wheel 20 causes the slotted disk 24 to rotate and this operates the proximity switch 26 to generate a second signal representative of the speed of the material 16. The second signal is also fed to the processing means 38.

The processing means 38 comprises an amplification means 40 for amplifying the signal received from the load transducer 14.

The processing means 38 further comprises a multiplier 42 for multiplying the signal output from the amplifier 40 and the signal received from the proximity switch 26. An output from the multiplier 42 is then filtered and fed to a scaling and pulse conversion module 44. The scaling and pulse conversion module 44 has two outputs which provide an indication of mass flow rate on a meter 46 and totalisation of material weighed on a display 48. The processing means 38 comprises standard electronic components which will be readily realisable to a person skilled in the art. Hence, the circuitry of the processing means 38 is not described any further.

It is an advantage of the invention that, other than the wheel 20, the apparatus 10 comprises no moving parts and hence the reliability of the apparatus 10 is improved in comparison with other weighing apparatus of which the applicant is aware. Further, due to the orientation of the load transducer 14 relative to the weigh chute 12, it is not necessary to compensate for the effect of frictional forces generated between the materials 16 and the weigh chute 12.

The apparatus 10 in accordance with the invention can be used for any free or semi-free flowing materials and can be built and calibrated according

to any capacity requirement.

Claims

1. A method of weighing a continuous stream of fluent material comprising the steps:

directing the material onto a feed means which, in the direction of flow of the material is arranged in a plane at an acute angle relative to a vertical plane at least at the outlet thereof;

feeding the material into a weigh chute which is completely arranged in a plane at an acute angle relative to a vertical plane, at least the outlet of the feed means being arranged at substantially the same angle as the weigh chute and being co-axially aligned with the weigh chute;

measuring the component of the load applied by the material to the weigh chute substantially perpendicular to the plane of the surface of the weigh chute thereby to neutralise the effect of any frictional forces generated between the material and the weigh chute and generating a first signal representative of mass of the material;

measuring the speed of flow of the material and generating a second signal representative of the speed of flow of the material; and

processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material.

2. The method as claimed in claim 1,

wherein the load applied by the material to the weigh chute is measured by a load transducer.

3. The method as claimed in claim 1 or 2,

comprising the steps:

amplifying the first signal;

multiplying the amplified first signal and the second signal;

filtering, scaling and pulse converting the multiplied signal;

indicating the mass flow rate and the totalisation of material weighed.

4. Apparatus for weighing a continuous stream of fluent material (36) comprising:

a feed means (28);

a weigh chute (12) through which the material can pass which is completely arranged in a plane at an acute angle relative to a vertical plane;

a load measuring means (14) for measuring a component of the load imparted by the material to the weigh chute (12), said load measuring means (14) being operable to generate a first signal representative of mass of the material;

a speed measuring means (18) for measuring the speed of flow of the material and for generating a second signal which is representative of the speed of flow of the material; and

a processing means (38) for processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material,

characterized in that

said feed means (28) is arranged in use, in the direction of flow of the material, in a plane which is at an acute angle relative to a vertical plane at least at the outlet thereof;

at least the outlet of the feed means (28) is arranged at substantially the same angle as the weigh chute (12) and being co-axially aligned with the weigh chute (12); and

the load measuring means (14) is arranged to measure the component of the load applied by the material to the weigh chute substantially perpendicular to the plane of the surface of the weigh chute, thereby to neutralise the effect of any frictional forces generated between the material and the weigh chute (12).

5. The apparatus as claimed in claim 4,

wherein the load measuring means comprises a load transducer (14) which supports the weigh chute (12).

6. The apparatus as claimed in claim 4 or 5,

wherein the speed measuring means (18) comprises a speed-measuring wheel (20) having a ribbed surface (22) on which the material impinges to rotate the wheel, the wheel (20) being arranged at an outlet end of the weight chute (12) and the speed measuring means (18) further including a monitoring means (24,26) for monitoring the speed of rotation of the wheel, the monitoring means (24,26) generating the second signal.

7. The apparatus as claimed in claim 4 or 5 or 6,

wherein the feed means (28) and the weigh chute (12) are made of polished stainless steel.

8. The apparatus as claimed in claim 6 or 7,

wherein the speed-measuring wheel (20) is made of light-weight material and is mounted on low-friction bearings.

9. The apparatus as claimed in any one of claims 4 to 8,

wherein the processing means (38) includes an amplifier (40), a multiplier (42) and a scaling and pulse conversion module (44).

10. The apparatus as claimed in any one of claims 4 to 9,

wherein the outputs of the processing means (38) are connected to a mass flow rate meter (46) and to a display (48) for totalisation of material weighed.

Patentansprüche

1. Ein Verfahren zum Wiegen eines kontinuierlichen Stroms fließenden Materials, umfassend die Schritte:

Lenken des Materials auf eine Zufuhrvorrichtung, die in Richtung des Materialstroms zumindest an ihrem Auslaß in einer bezüglich einer vertikalen Ebene in einem spitzen Winkel angeordneten Ebene angeordnet ist;

Zuführen des Materials in eine Wägerutsche, die vollständig in einer bezüglich einer vertikalen Ebene in einem spitzen Winkel angeordneten Ebene angeordnet ist, wobei mindestens der Auslaß der Zufuhrvorrichtung im wesentlichen unter demselben Winkel wie die Wägerutsche angeordnet und koaxial mit der Wägerutsche ausgerichtet ist;

Messen der von dem Material auf die Wägerutsche in einer zur Ebene der Oberfläche der Wägerutsche im wesentlichen senkrechten Ebene ausgeübten Belastungskomponente, um dadurch die Wirkung jeglicher zwischen dem Material und der Wägerutsche erzeugter Reibkräfte zu neutralisieren, und Erzeugen eines ersten Signals, das für die Masse des Materials kennzeichnend ist;

Messen der Fließgeschwindigkeit des Materials und Erzeugen eines zweiten Signals, das für die Fließgeschwindigkeit des Materials kennzeichnend ist; und

Verarbeiten des ersten Signals und des zweiten Signals, um ein Ausgangssignal zu erhalten, das für den Massendurchsatz des Materials kennzeichnend ist.

2. Das Verfahren nach Anspruch 1,

dadurch gekennzeichnet, daß die von dem Material auf die Wägerutsche ausgeübte Belastung von einem Belastungsumformer gemessen wird.

3. Das Verfahren nach Anspruch 1 oder 2,

umfassend die Schritte:

Verstärken des ersten Signals;

Multiplizieren des verstärkten ersten Signals und des zweiten Signals;

Filtern, Skalieren und Durchführen einer Pulsumformung des multiplizierten Signals

Anzeigen des Massendurchsatzes und des Summenwerts von gewogenem Material.

4. Vorrichtung zum Wiegen eines kontinuierlichen Stroms fließenden Materials (36), umfassend:

eine Zufuhrvorrichtung (28),

eine Wägerutsche (12), durch welche das Material passieren kann, welche vollständig in einer bezüglich einer vertikalen Ebene in einem spitzen Winkel angeordneten Ebene angeordnet ist;

eine Belastungsmeßvorrichtung (14) zur Messung einer Komponente der von dem Material auf die Wägerutsche (12) ausgeübten Belastung, wobei die besagte Belastungsmeßvorrichtung (14) betätigbar, ist um ein erstes Signal zu erzeugen, das für die Masse des Materials kennzeichnend ist;

eine Geschwindigkeitsmeßvorrichtung (18) zur Messung der Fließgeschwindigkeit des Materials und zur Erzeugung eines zweiten Signals, das für die Fließgeschwindigkeit des Materials kennzeichnend ist; und

eine Verarbeitungsvorrichtung (38) zum Verarbeiten des ersten Signals und des zweiten Signals, um ein Ausgangssignal zu erhalten, das für den Massendurchsatz des Materials kennzeichnend ist,

dadurch gekennzeichnet, daß

die besagte Zufuhrvorrichtung (28) im Betrieb in der Fließrichtung des Materials in einer Ebene angeordnet ist, die mindestens an ihrem Auslaß bezüglich einer vertikalen Ebene in einem spitzen Winkel angeordnet ist;

mindestens der Auslaß der Zufuhrvorrichtung (28) im wesentlichen unter dem gleichen Winkel wie die Wägerutsche (12) angeordnet und koaxial mit der Wägerutsche (12) ausgerichtet ist; und

die Belastungsmeßvorrichtung (14) so angeordnet ist, daß sie die Belastungskomponente der vom Material auf die Wägerutsche ausgeübten Belastung mißt, die im wesentlichen senkrecht zu der Ebene der Oberfläche der Wägerutsche ausgerichtet ist, um dadurch die Wirkung jeglicher zwischen dem Material und der Wägerutsche (12) erzeugter Reibkräfte zu neutralisieren.

5. Die Vorrichtung nach Anspruch 4,

dadurch gekennzeichnet, daß die Belastungsmeßvorrichtung einen Belastungsumformer (14) umfaßt, der die Wägerutsche (12) trägt.

6. Die Vorrichtung nach Anspruch 4 oder 5, dadurch gekennzeichnet, daß die Geschwindigkeitsmeßvorrichtung (18) ein Rad (20) zum Messen der Geschwindigkeit umfaßt, das eine gerippte Oberfläche (22) besitzt, auf welche das Material aufprallt, um das Rad zu drehen, wobei das Rad (20) an einem Auslaßende der Wägerutsche (12) angeordnet ist, und daß die Geschwindigkeitsmeßvorrichtung (18) weiter eine Überwachungsvorrichtung (24,26) zum Überwachen der Drehgeschwindigkeit des Rades einschließt, wobei die Überwachungsvorrichtung (24,26) das zweite Signal erzeugt.

7. Die Vorrichtung nach einem der Ansprüche 4 oder 5 oder 6, dadurch gekennzeichnet, daß die Zufuhrvorrichtung (28) und die Wägerutsche (12) aus nichtrostendem Stahl mit glatter Oberfläche hergestellt sind.

8. Die Vorrichtung nach Anspruch 6 oder 7, dadurch gekennzeichnet, daß das Rad (20) zum Messen der Geschwindigkeit aus einem leichten Material hergestellt und auf reibungsarmen Lagern montiert ist.

9. Die Vorrichtung nach einem der Ansprüche 4 bis 8, dadurch gekennzeichnet, daß die Verarbeitungsvorrichtung (38) einen Verstärker (40), einen Multiplizierer (42) und ein Skalierungs- und Pulsumformermodul (44) einschließt.

10. Die Vorrichtung nach einem der Ansprüche 4 bis 9, dadurch gekennzeichnet, daß die Ausgänge der Verarbeitungsvorrichtung (38) mit einem Meßgerät (46) für den Massendurchsatz und einer Anzeige (48) für den Summenwert von gewogenem Material verbunden sind.

Revendications

1. Procédé pour peser un flux continu de matériau fluide comprenant les étapes consistant à :

diriger le matériau sur un moyen d'alimentation qui, dans le sens de l'écoulement du matériau, est disposé dans un plan à un angle aigu par rapport à un plan vertical à au moins son orifice de sortie ;

délivrer le matériau dans une goulotte de pesage qui est totalement disposée dans un plan à un angle aigu par rapport à un plan vertical, au moins l'orifice de sortie du moyen d'alimentation étant disposé pratiquement au même angle que la goulotte de pesage et étant coaxialement aligné avec la goulotte de pesage ;

mesurer la composante de la charge appliquée par le matériau à la goulotte de pesage pratiquement perpendiculaire au plan de la surface de la goulotte de pesage pour neutraliser de ce fait l'effet de toutes forces de frottement quelconque produites entre le matériau et la goulotte de pesage, et produire un premier signal représentatif d'une masse de matériau ;

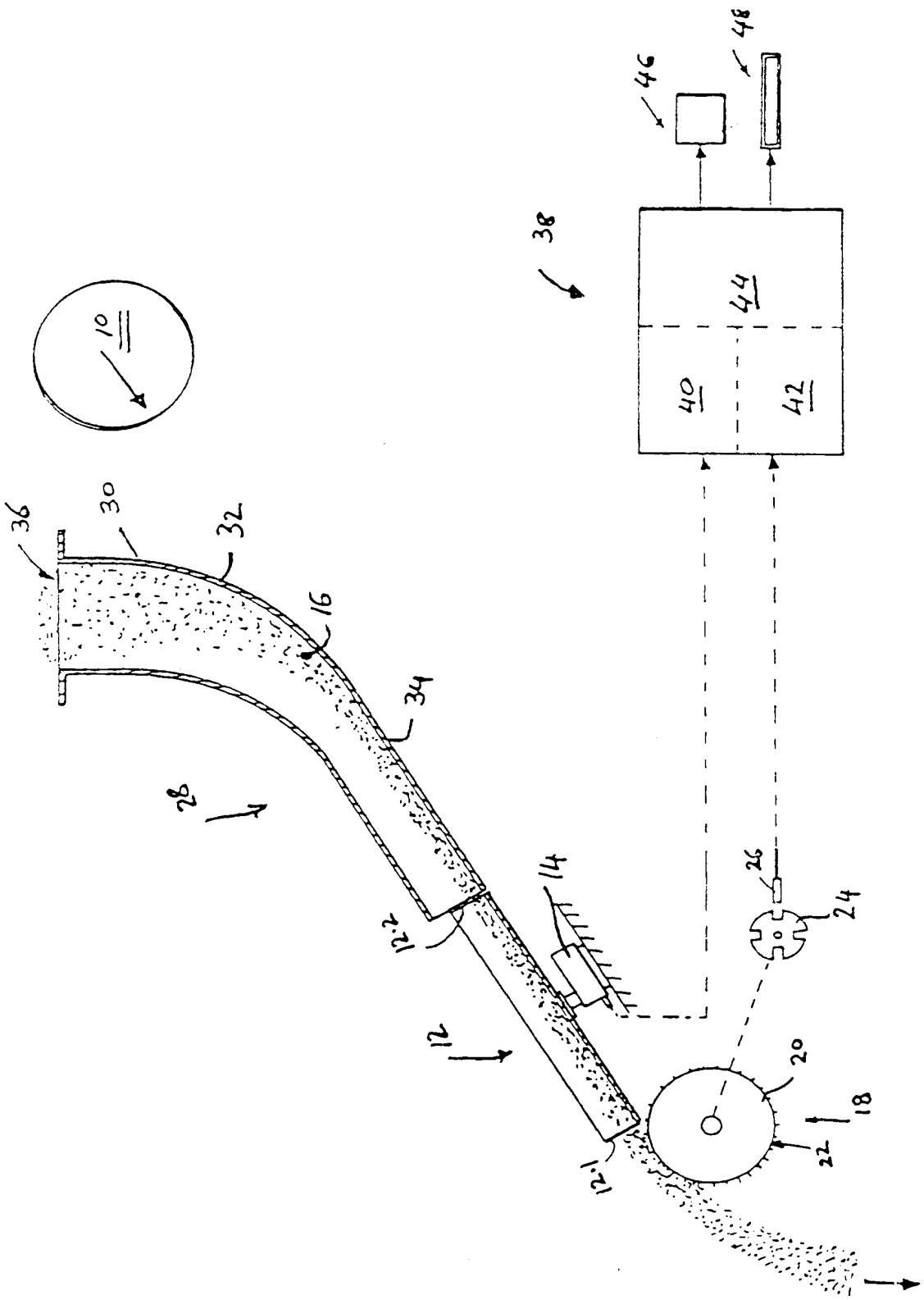
mesurer la vitesse de l'écoulement du matériau et produire un second signal représentatif de la vitesse de l'écoulement du matériau, et

traiter le premier signal et le second signal afin d'obtenir un signal de sortie qui est représentatif du débit de la masse du matériau.

2. Procédé selon la revendication 1, dans lequel la charge appliquée par le matériau à la goulotte de pesage est mesurée par un transducteur de charge.

3. Procédé selon la revendication 1 ou 2, comprenant les étapes consistant à :
amplifier le premier signal ;
multiplier le premier signal amplifié et le second signal ;
filtrer, mettre à l'échelle et convertir en impulsions le signal multiplié ;
indiquer le débit de la masse et la totalisation du matériau pesé.

4. Appareil pour peser un flux continu d'un matériau fluide (36) comprenant :
un moyen d'alimentation (28) ;
un goulotte de pesage (12) par laquelle le matériau peut passer, laquelle est totalement disposée dans un plan à angle aigu par rapport à un plan vertical ;
un moyen de mesure de charge (14) pour mesurer une composante de la charge communiquée par le matériau à la goulotte de pesage (12), le moyen de mesure de charge (14) pouvant être mis en oeuvre pour produire un premier signal représentatif de la masse du matériau ;
un moyen de mesure de vitesse (18) pour mesurer la vitesse de l'écoulement du matériau et pour produire un second signal qui est représentatif de la vitesse de l'écoulement du matériau, et
un moyen de traitement (38) destiné à traiter le premier signal et le second signal afin d'obtenir un signal de sortie qui est représentatif du débit de la masse du matériau.


10
36
30
32
16
34
28
12.2
12.1
12
14
26
24
20
18
22
38
40
42
44
46
48

caractérisé en ce que :

le moyen d'alimentation (28) est disposé en utilisation, dans le sens d'écoulement du matériau, dans un plan qui est à angle aigu par rapport à un plan vertical à au moins son orifice de sortie ,

au moins l'orifice de sortie du moyen d'alimentation (28) est disposé pratiquement au même angle que la goulotte de pesage (12) et est coaxialement aligné avec la goulotte de pesage (12), et

le moyen de mesure de charge (14) est disposé pour mesurer la composante de la charge appliquée par le matériau à la goulotte de pesage pratiquement perpendiculaire au plan de la surface de la goulotte de pesage, afin de neutraliser de ce fait l'effet de toutes forces de frottement produites entre le matériau et la goulotte de pesage (12).

5. Appareil selon la revendication 4,

dans lequel le moyen de mesure de charge comprend un transducteur de charge (14) qui supporte la goulotte de pesage (12).

6. Appareil selon la revendication 4 ou 5,

dans lequel le moyen de mesure de vitesse (18) comprend une roue de mesure de vitesse (20) comportant une surface nervurée (22) que le matériau heurte ce qui amène la roue à tourner, la roue (20) étant disposée à une extrémité d'orifice de sortie de la goulotte de pesage (12) et le moyen de mesure de vitesse (18) comportant de plus un moyen de surveillance (24, 26) pour surveiller la vitesse de rotation de la roue, le moyen de surveillance (24, 26) produisant le second signal.

7. Appareil selon l'une quelconque des revendications 4 ou 5 ou 6,

dans lequel le moyen d'alimentation (28) et la goulotte de pesage (12) sont constitués d'acier inoxydable poli.

8. Appareil selon la revendication 6 ou 7,

dans lequel la roue de mesure de vitesse (20) est constituée d'un matériau de faible poids et est montée sur des paliers à faible frottement.

9. Appareil selon l'une quelconque des revendications 4 à 8,

dans lequel le moyen de traitement (38) comporte un amplificateur (40), un multiplicateur (42) et un module de mise à l'échelle et de conversion d'impulsion (44).

10. Appareil selon l'une quelconque des revendications 4 à 9,

dans lequel les sorties du moyen de traitement (38) sont connectées à un compteur de débit de masse (46) et à un afficheur (48) pour totalisation d'un matériau pesé.